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(54) Title: INSTALLATION OF FOAM INSULATION

(57) Abstract

A method and product produced thereby of bonding insulation board to a substrate. The method comprises applying by spraying a layer of an adhesive (which may be foamed by water or a fluorocarbon) to a substrate, positioning the insulation board on the substrate in the desired position prior to curing the adhesive followed by curing the adhesive. The adhesive consists of a heated mixture of a polyurethane adhesive and an isocyanate curing catalyst which are admixed at substantially equal viscosities in a proportion to permit curing the adhesive at a temperature of less than 140°F. The insulation board is positioned on the adhesive preferably from about one to about ten minutes after spraying the adhesive layer onto the surface of the substrate.

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INSTALLATION OF FOAM INSULATION

Low cost bituminous products have for years been used as roofing materials. Asphalt, which is a leftover sludge from the oil manufacturing process, merely needed to be heated and transported to the roof. Upon cooling, a satisfactory roofing material was achieved. However, in present times, improved insulating board and other roofing materials are sought to be used to increase the energy efficiency of the roof. Labor costs have become extremely high in handling asphalt, since it must be applied at relatively high temperatures and is an expensive and dangerous occupation, having a very high workman's compensation rate. In some areas this workman's compensation rate may equal as much as one-third of the base wages paid to the workman applying the same.

Such a roof construction frequently includes the use of a metal, concrete or wooden underdeck or substrate upon which a mineral board is bonded, followed by three or four layers of felt and finally the asphalt or tar. The tar is applied at approximately 400°F., in order to keep it fluid, which causes damage to the more energy efficient insulating boards such as styrofoam, and urethane board stock. Melting of these high energy efficient layers not only decreases the efficiency but causes channels for moisture which may produce severe roof damage and possible leakage.

When asphalt or tar is used as a first adhesive layer on a roof over such a prior art substrate, the damage to the insulating board can be minimized by waiting until the asphalt has cooled to a reasonably acceptable temperature, but this requires careful coordination between the application of the asphalt and the positioning of the insulation board. Often times

too hot or too cold temperatures causes improper bonding. If other adhesives are employed, expensive layers of felt or other materials are still needed to protect the insulation from the final covering of asphalt.

SUMMARY OF THE INVENTION

To eliminate as much as possible the use of asphalt and other hot tar materials in roofing, a new method of bonding insulation board to a substrate has been developed. This method includes steps of applying a layer of an adhesive to a substrate, the adhesive comprising a heated mixture of a polyurethane adhesive and an isocyanate curing catalyst admixed in a proportion to permit curing the adhesive at a temperature less than 140°F., positioning insulation board on the substrate prior to curing the adhesive and curing said adhesive. Preferably, the insulation board is positioned on the adhesive after from one to about ten minutes after the adhesive layer is applied to the substrate.

In a preferred embodiment, the adhesive and the catalyst are admixed at a substantially equal viscosity to permit total and quick mixing. Simply, the adhesive and the catalyst are heated separately to control their viscosities, whereby at the mixing stage, the viscosities are essentially equal.

To promote the formation of an adhesive bond and insure optimum contact with the substrate and the insulation board, it is preferred to include a gas producing agent in the adhesive to cause cellular formation of the adhesive upon curing. One preferred method is to include a quantity of fluorocarbon added to the mixture during the admixing step. Another method which is preferred is to include a quantity of water admixed with the adhesive and catalyst for reaction therewith to form carbon dioxide.

Preferably, when the adhesive and the catalyst are at equal viscosities, a proportion of the mixture comprises approximately 50 to 70 parts by weight of the polyurethane and 30 to 50 parts by weight of the catalyst. Most preferred is a proportion of about 60 parts by weight of the polyurethane for every 40 parts by weight of the catalyst.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In a conventional roofing operation, the metal, concrete or wood substrate is covered with asphalt, followed by one or more layers of an insulation board. In the case where styrene is employed, substantial time must pass to permit the asphalt to cool to a temperature which will not adversely affect the polystyrene-foam. Next, particle board of some type is put down to cover the polystyrene followed by laminated layers of thick hot melt of asphalt and multiple layers of roofing paper. The attendant hot expensive dangerous prior art operation is then complete.

In the preferred embodiment of this invention, polyurethane adhesive of the present invention is initially sprayed onto the metal, wood or cement substrate to cover the surface of the substrate. Polyurethane adhesives are very fluid at the temperatures used herein and therefore flatten to conform to the surface to which it is applied. Since the temperature is below 140°F., and is preferably from about 100° to 130°F., any insulation board can then be applied immediately upon application of the adhesive. If desired, a second layer of adhesive on the top of the insulation board can be applied to bond the next layer, which can be insulation board, particle board or felt. In each step, a layer of the adhesive can be applied to bond the next layer, which can be insulation board, particle board or felt. In each step, a layer of the adhesive can be

placed on the insulation material to bind it to the next layer to be added. Because the adhesive will adhere to the insulation board being applied during a period of from about one to about ten minutes or even more, one person can spray a large area and then apply the insulation board over this entire area. Alternative prior methods using asphalt would require three or four men working to accomplish the equivalent amount of roofing in the same period of time.

A foamable polyurethane adhesive resin has been found to be acceptable. A preferred adhesive is polyurethane adhesive 821WB, manufactured by Witco Chemical Company, New Castle, Delaware. This is a hydroxy terminated polyether resin. Again, any of the isocyanate catalysts may be employed but particularly preferred is isocyanate catalyst 821WA, also manufactured by Witco Chemical Company.

In the most preferred embodiment, the two components, the adhesive and the catalyst, are maintained in separate tanks. Through a positive displacement pump, the two components are transferred to a heater, then through a heated hose to a mixing spray gun which mixes, disburses, and gasifies the components to produce a cellular adhesive. The presence of water in the mixture of adhesive and catalyst will cause the formation of carbon dioxide during the cure, to produce a cellular adhesive. Alternatively, a fluorocarbon may be added during the admixing step to produce the cellular product. A preferred means of distributing the adhesive is the use of a spray gun. The spray guns have a plurality of conduit elements to receive the catalyst and the adhesive and carry the same to a mixing chamber for intimately mixing the same and also forming the mixture into a gaseous state for spraying. The Gusmer advanced model D automatic self clean-

ing spray gun provides airless atomization of the product. This gun is manufactured by the Gusmer Corporation, Old Ridge, New Jersey, and is a preferred means for spraying the catalyst and adhesive mixture.

To evaluate the efficiency of the present invention, a number of experiments were performed. These experiments, the urethane adhesive and the isocyanate catalyst were combined in various ratios ranging from about 50 parts to 70 parts by weight of the polyurethane and from about 30 parts to about 50 parts by weight of the isocyanate catalyst. All of these formulations performed adequately in bonding various insulation boards to substrates. Particularly preferred the formulations were in the proportion of polyurethane is about 60 parts by weight for every 40 parts by weight of catalyst.

Most successful were those tests where the viscosities of the adhesive and catalyst were controlled by preheating them prior to mixing. Since rapid and complete mixing took place, no tests were unsuccessful.

These formulations were tested for bonding various insulation boards such as styrofoam, urethane boards, laminated urethane boards, mineral boards such as biltrite, pearlite, and various laminated felt products. These insulation boards were bonded to various substrates such as metal, cement and wood decks. In each case, it was discovered that the insulation board was rapidly and efficiently bonded to the substrate without difficulty and required a great deal less labor than prior asphalt methods.

Having thus described the invention, what is claimed is:

1. A method of bonding insulation to a subtrate, comprising:

applying a layer of an adhesive to a substrate, said adhesive comprising a heated mixture of a polyurethane adhesive and an isocyanate curing catalyst admixed in a proportion to permit curing said adhesive at a temperature less than 140°F.;

positioning insulation board on said adhesive in a desired position on said substrate prior to curing said adhesive; and

curing said adhesive.

2. The method of claim 1 wherein the adhesive and catalyst are applied by spraying the same onto the substrate.

3. The method of claim 2 wherein said insulation board is positioned on said adhesive from one to ten minutes after applying the adhesive to said substrate.

4. The method of claim 3 wherein said adhesive and said catalyst are admixed at substantially equal viscosities.

5. The method of claim 4 wherein said adhesive and said catalyst are heated to control said viscosities.

6. The method of claim 5 wherein said layer includes a gas producing agent for causing a cellular formation of said adhesive upon curing.

7. The method of claim 6 wherein said gas producing agent comprises a quantity of water admixed with said adhesive and catalyst for reaction with said adhesive and catalyst to form carbon dioxide during the curing of the adhesive.

8. The method of claim 6 wherein said gas producing agent comprises a fluorocarbon added to said adhesive and said catalyst during said admixing step.

9. The method of claim 1 wherein said admixture comprises a proportion of about 50 to 70 parts by weight of said polyurethane for every 30 to 50 parts by weight of said catalyst.

10. The method of claim 9 wherein said proportion is about 60 parts by weight of said polyurethane for every 45 by weight of said catalyst.

11. An insulation material mounted on a surface, comprising a substrate having an amount of insulation bonded thereto by an adhesive applied to said substrate, said adhesive comprising a polyurethane adhesive and an isocyanate curing catalyst admixed in the proportion to permit curing said adhesive at a temperature less than 140°F.

12. The composition of claim 11 wherein said insulation is positioned on the said adhesive from one to ten minutes after applying said adhesive to said substrate.

13. The composition of claim 11 wherein said adhesive and said catalyst have been admixed at substantially equal viscosity.

14. The composition of claim 13 wherein said adhesive and said catalyst are heated to control said viscosities.

15. The composition of claim 11 wherein said layer includes a gas producing agent for causing cellular formation of said adhesive upon curing.

16. The composition of claim 15 wherein said gas producing agent comprises a quantity of water admixed with said adhesive and catalyst for reaction with said adhesive and catalyst during curing to form carbon dioxide.

17. The composition of claim 15 wherein said gas producing agent comprises a fluorocarbon added to said

adhesive and catalyst during said admixing step.

18. The composition of claim 11 that admixture comprises a proportion of about 50 to 70 parts by weight of said polyurethane for every 30 to 50 parts by weight of said catalyst.

19. The composition of claim 18 wherein said proportion is about 60 parts by weight of said polyurethane for every 40 parts by weight of said catalyst.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US/01469

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁵

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.³ - B32B 5/18; B32B 27/40; C09J 5/02; E04B, 7/00; E04C 1/00

(Cont. on suppl. sheet 1)

II. FIELDS SEARCHED

Minimum Documentation Searched ⁶

Classification System	Classification Symbols
U.S.	156/71, 78, 307.3, 331.4 525/457 (Cont. on suppl. sheet 1)

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁶

NONE

III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴

Category ⁶	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
X	US,A, 3,106,751 Published 15 October 1963 FISH	1-7,9-16, 18-19
X	CA,A, 627,039 Published 5 September 1961 FORBES	1-7,9-16, 18-19
X	US,A, 4,224,376 Published 23 September 1980 ISHIGE ET AL.	1-7,9-16, 18-19
X	US,A, 2,929,800 Published 22 March 1960 HILL	1-7,9-16, 18-19
X	GB,A, 970,308 Published 16 September 1964 SCHERING AKTIEN.	1-7,9-16, 18-19
X	US,A, 3,804,931 Published 16 April 1974 MILLER	8,17

* Special categories of cited documents: ¹⁵

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"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search ²	Date of Mailing of this International Search Report ²
3 December 1981	06 JAN 1982
International Searching Authority ³	**Signature of Authorized Officer**
ISA/US	J. V. Gallagher

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FURTHER INFORMATION CONTINUED FROM THE FIRST SHEET
(Not for publication)

I. CLASSIFICATION OF SUBJECT MATTER (cont.)

U.S. CL. - 156/71, 78, 307.3, 331.4;
428/320, 423.1;
52/309.3, 309.5 309.8, 309.13, 746.

II. FIELDS SEARCHED (cont.)

U.S. 52/309.3, 309.5, 309.8, 309.13, 746
428/423.1, 320
427/422, 426